

never with impunity treat seedlings in India in the rough manner in which they are treated in a temperate climate. Here they are lifted, tied in bundles, tossed into a cart, and transported to Ireland, or even across the Atlantic to Canada (where I was astonished to hear Messrs. Lawson have contracts for planting), in a manner marvellous to an Indian forester accustomed to deal with each individual seedling in a careful manner, and to see even the slightest rough handling result in the loss of the young tree. I cannot help thinking that our nursery management admits of much improvement; hence the cause of the extreme delicacy of our young trees. I saw all the operation of lifting and packing the young trees, besides transplanting, &c.

The crop of hard wood in the nurseries is not extensive, but includes all the principal species most in demand.

I had almost forgotten to note that there are several beds of deodar doing well, and *Cupressus torulosa* flourishes here as well as on the Neilgherry and Pulney Hills.

THE EARL OF SEAFIELD'S WOODS AND PLANTATIONS IN STRATHISPEY.

I spent a week in Strathspey, and obtained much valuable information as to the growth of *coniferae* from Mr. Grant Thomson, Lord Seafield's wood manager, to whom I am greatly indebted for his courtesy and the anxiety he evinced to show me all he could in the time at my disposal.

The tract of country, chiefly moorland, under his charge extends to at least 60,000 acres, of which 30,000 to 40,000, or a little more than half, is now actually under timber. Mr. Thomson's wish is gradually to plant up the whole, so that, in the course of time, 1,000 acres could be felled annually, and a like extent planted out, and I think the object cannot be too steadily kept in view, as it could not fail to bring in a large revenue, without impoverishing the forests, or, so to speak, trenching on the capital in timber.

Mr. Grant Thomson considers that the sale of thinnings, grazing dues, &c., should suffice not only to pay the establishments employed (including his own salary), and the working expenditure for the nursery planting, fencing, &c., but also the rental of the land, which of course is very low, leaving all the proceeds from actual clearing, or what is known as a "clean cut," as clear profit.

The woodlands are divided into three districts, known as Grantown, Abernethy, and Duthil, each under the immediate charge of a forester, who is responsible to Mr. Thomson for all the work of his district.

Abernethy is by far the largest district, and Mr. Sampson, the forester there, is highly spoken of by Mr. Thomson, and appears particularly intelligent and zealous in the performance of his duties, which include the charge of the nurseries, floating timber down the Nethy, and the management of extensive planting and thinning operations.

The nurseries cover a space of about 13 acres, of which from 10 to 11 acres are at present under crop, principally Scotch fir.

The nursery management differs in no material respect from that in force at Messrs. Lawson & Co., excepting that here, as a rule, the young trees are received as purchased from market nurseries, as one or two years seedlings, or one year seedlings and one year bedded. They are then kept a year, or sometimes two, in the Abernethy nursery previous to planting out for good.

It is doubtful whether the nursery would not have been better situated near Mr. Thomson's house at Grantown, which is more central, and not so exposed, but the healthy condition of the young trees, and neatness of the Abernethy nursery, speak volumes for Mr. Sampson's care and the system in force.

I saw three lines of Scotch firs lifted and tied in bundles for planting out.

This is done very expeditiously by two men, with the "grape," or five-pronged fork, digging out the young trees in the lines, which are then lifted in bunches by the women, the loose earth shaken off, and the plants tied in bundles of convenient size. The average number of young trees in each row is previously ascertained, and now and then a row is counted as dug up, as a check; but Mr. Thomson informed me that, after a little experience, a workman or woman could tell by touch, to within one or two, the number in a bundle or bunch.

As a rule, the young trees are lifted one day, conveyed to the ground early the next, and planted out before that evening, so as to obviate, as much as possible, any risk of loss, such as has been known to occur, when a number of plants are *steepled* (i.e., stored, with a coating of earth round their roots, in a sheltered corner) on the ground ready for planting, and operations suspended by snow so long that almost all were destroyed by rot.

I saw a couple of beds in the nursery which had been sown by the candidates selected for the Indian Forest Department, who were here last year. The seedlings were coming up well, but a little too thickly, which is generally the case with amateur sowing.

The nursery contains specimens of *Wellingtonia gigantea*, *Cupressus torulosa*, *Araucaria imbricata*, &c., and is conveniently situated close to the forester's house.

Plantations.—I inspected nine plantations, varying in extent from 300 to 1,200 acres, and had thus the opportunity of seeing the young trees at all ages and under the most varied circumstances as to soil, altitude, and exposure.

The bulk of the plantations consist of Scotch fir, with a comparatively small number of spruce and larch. On an average, particularly in the portions planted out since Mr. Thomson has been in charge, the proportions are 2,000 Scotch fir to 500 larch to the imperial acre, but in some exposed situations there may be 3,000 plants to the acre.

I do not include under this head any trees over 15 years of age, which I shall notice briefly under the head of woods.

The oldest plantations which I visited were Tulquhonic, in the Dutch district, extending over 600 or 700 acres, and Tulchan (400 to 500 acres), in the Abernethy district, of which about 100 acres have been planted 11 or 12 years ago. In both, particularly the former, the Scotch firs are very healthy and regular on the ground, with an average height, in favourable situations, of from 10 to 12 feet, and in the most unfavourable spots reaching to six or eight feet. The spruce is not frequent, and its growth contrasts unfavourably with the fir, whilst the larch, in some very sheltered spots, surpasses it in growth, but in no case presents so healthy and robust an appearance.

In the Duthil Hill Plantation, extending over 600 or 700 acres, where the plants average six years since first put out, their average height is from five to six feet.

In Deshar Plantation, 1,100 acres, enclosed seven years ago, and planted gradually since, the young Scotch firs average from four to five feet in favourable localities, with fine shoots for this year of 16 to 22 inches in length, but there is a marked difference in the exposed situations, where the young trees have not "come away" well, and do not average two feet high.

The larch in this plantation is not doing at all well. The same remarks apply to the Sluemore Plantation, in the Abernethy district, 500 to 600 acres, planted about five years ago, where the average height is three feet, and the plants are very healthy, particularly the fir.

In the Revack Plantation, of 700 acres, the young trees planted from three to four years ago are doing well, with the notable exception of some 10 acres on the westerly side, which was planted, against Mr. Thomson's judgment, the

year after the ground had been cleared of a former crop of trees, which had proved an entire failure, scarcely a single tree being left of those planted out. Mr. Thomson has found this the case in other instances, and considers that it may be laid down as an axiom that, in Strathspey at least, the land should be left barren and untouched, after it is cleared of trees, until the natural herbage, whether heather, grass, or moss, which existed before the trees grew, recovers; and that if planted before this takes place failure will result. No definite time can be laid down for this operation of nature, but the fact is fully borne out by observations of the natural or self-sown tracts to be noticed further on in this Report.

We may find this apply in India, though it certainly does not in replacing the natural wood by the Australian *Eucalypti* and *Acaciæ* on the hills, and it will be noticed in remarks on Lord Mansfield's woods (page 113), that Mr. McCorquodale, with the experience of 30 years, does not agree with Mr. Thomson, although he admits that young trees, planted in the usual method, will not do, owing to the attacks of the beetle.

The Bengulapin Plantation, 1,000 to 1,200 acres, in Duthil district, is particularly noteworthy, from the fact that here we find the Scotch fir planted and doing well up to a height of 2,000 feet above the level of the sea. This large extent of moorland has been gradually planted, the oldest plants having been out six and the youngest only two years. A belt of old Scotch fir has been judiciously left as a screen to the young trees standing on the westerly side, whence come the prevailing winds. Those at the summit were planted out last, as Mr. Thomson finds from experience that they will only grow in such situations, where they are exposed to wind from all sides, if the lower portions of the hill are first planted, and a certain amount of shelter thus derived.

This fact should not be lost sight of in our hill plantations in India, where we suffer so much damage from the high winds. The young trees on the summit are not growing fast, but are healthy and strong. I did not observe a single casualty, and, when once firmly established, have no doubt of their "coming away" and eventually clothing the mountain even to its top. I attach much importance to this, as I have often heard it questioned, particularly in this country, whether trees could be grown to any advantage at such an altitude, and exposed to strong winds and storms.

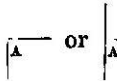

On the easterly side of this hill there are a good proportion of larches doing very well, the situation having been

judiciously chosen. It may here be noticed that Mr. Thomson has entirely given up the rigid system so much in vogue at one time, and with some wood managers, of planting alternately a Scotch fir, a larch, a spruce, or hard wood at certain distances, the interval of space being filled up with "nurses" of fir, spruce, or larch, in equal quantities, without any reference to the nature of the soil, expense, &c., and has adopted the much more sensible plan of putting down the tree which is most likely to do best, which in his opinion, fully borne out by appearances, is the Scotch fir on heather land and all exposed situations, and the larch on grass land and in sheltered spots, where the spruce will also do fairly.

I have now only to allude to the Advie Plantation, Abernethy district, of about 300 acres, in which the trees were planted out last autumn and this spring. They were then, as is the rule throughout, one year seedlings, one year bedded, and one year transplanted; and those put out in spring do not now average more than 6 or 8 inches from the ground, whilst those of last autumn, having made short shoots this year, may be 8 to 10 inches high. Still, they are all healthy, and Mr. Thomson is quite satisfied if they establish themselves during the first twelve months. It struck me at first that they might be put out taller, but Mr. Thomson informed me that this had been tried, and the result was greater difficulty and risk in moving from the rows in nursery, and a large per-centage of loss by their getting wind-shaken when planted out on the hill side, the extra year in the nursery without re-transplanting representing an upward growth of 6 to 8 inches.

It cannot be too clearly borne in mind that the great aim in the nurseries in this country is to grow root fibre, and check the upward growth of the young tree, which is effected, as already detailed in the description of Messrs. Lawson's Nurseries, by frequently transplanting, and cutting over the roots. Whether this might not, in some cases, be advantageously introduced into our Indian practice, I am not competent to say, but think it merits attention and experiment.

All the trees are planted out by what is termed "slitting," as clearly explained in "Brown's Forester," "Grigor's Arboriculture," &c., viz., two cuts with the spade at right

angles, thus  or , the plant being inserted at the point A, where both meet, and the earth then firmly pressed down with the heel. Before inserting the spade the man

removes a small sod of the coarse heather or turf, which might otherwise choke the young tree. The distances are not measured, or even roughly pegged out, but there is wonderful uniformity, the men being drawn up in a row before starting, and each taking his own line. One woman is told off to every two men, to supply plants, and she in turn is supplied by other women, who bring the plants from the place where they are stored. In this manner two men and a woman can plant at least an acre *per diem*, and the cost, including leading of young plants from the nursery, does not exceed 3s. 6d. per thousand, or say, 10s. per acre of 3,000 trees.

Self-sown Fir and Larch.

The natural reproduction of the Scotch fir and larch is seen to great advantage in Strathspey.

Wherever the natural herbage or vegetation has sprung up in places formerly covered with coniferous trees, and in the vicinity, the seeds appear to germinate, and a crop appears, sometimes thick and even enough to render re-planting unnecessary.

Mr. Thomson's plan is to enclose (by wire fences) tracts where he sees this natural reproduction commencing, and in some cases, where the surface is mossy or covered with rank coarse grass, to assist nature by removing sods every few paces, thus giving the seeds and seedlings a chance of coming on. This promises to be very successful. We found several young trees coming up in every space thus bared. For the same reason, as well as for shelter, as already explained under "Plantations," clumps of old trees are left on the ground, the cones of which disseminate the seed.

I visited several tracts where the process of natural reproduction had taken place, and though the growth is not rapid at first, and the tracts naturally present a very uneven appearance compared with those artificially planted, the young trees after the first few years appear to "come away" with fine straight and strong shoots, some of which we measured, and found that for this year the growth had been two and even two and a quarter feet.

In a large tract of self-sown forest in the Grantown district, inclosed six years ago, the Scotch firs average certainly 6 feet high, whilst individual trees run up to 10 feet. The growth of the larch is not quite so good, but I saw some fair specimens.

It is particularly noteworthy that wherever the heather presents itself as the natural herbage, the Scotch fir is the tree which springs up, whilst on grass land the larch, and

even the spruce, already stated to be comparatively rare in this part, are more frequent. It is from observing this natural result that Mr. Thomson arrives at his conclusions as to where to plant the several species, as noted under the head of "Plantations," and the results fully justify his doing so.

In the Cranish Inclosure, Duthil district, there is a fine growth of natural Scotch fir and spruce, with a little larch, and at the foot of Bengulapin there is a considerable extent of Scotch fir and birch, both self-sown.

Cattle, goats, sheep, &c. are, of course, rigidly excluded from the inclosures for the first ten years, and Mr. Thomson is fortunately not much troubled with rabbits or fallow deer.

The whole process is very similar to what we are doing, or trying to do, in Madras, under the name of "railway fuel reserves," but in this country there is not much danger from fires, though they have occurred, and Mr. Thomson appears to have no difficulty as to cattle trespass, rights of way, &c. He impounds any cattle found within the inclosures, and experiences no trouble nor delay in getting human trespassers adequately punished. Such offences are consequently very rare.

Woods.—These are of all ages, from the scattered park trees, near Castle Grant (Lord Seafield's residence), and some old veterans, probably 150 years old, in the Abernethy district, to the young woods of 15 years old.

There is not, however, so far as I could judge from so short a stay, much extent of mature wood ready for or requiring a clean cut, though there is an ample supply of thinings of all ages.

Birch is the only hard wood tree which occurs in any quantity, and it is little felled at present.

In thinning the coniferous trees, no rigid rule is laid down. They are generally gone over first when from 15 to 17 years old, and any sickly trees, or those which are affecting injuriously the growth of others, thinned out; but there is little or no sale for such first thinnings, as no hop poles are required, as in the south of England.

After the age just mentioned, the woods are gone over periodically, and a certain number of trees marked for thinning, and sold standing, in convenient lots, by tender or private bargain.

When none but mature trees are left standing (there are rarely 200 to the acre, and the wood is from 60 to 80 years old), there is what is termed a "clean cut," the trees being sold standing as above, and the purchaser bound to

remove them within certain dates, paying in advance for each lot before removal. The ground is then allowed to lie fallow until the natural herbage returns, as already described.

In selling thinnings, the felling, and sometimes the pruning are done by the proprietor, to prevent damage to the standing trees. In a clean cut the felling is almost invariably left to the purchaser. All felling, except in the case of saplings, is done with the cross-cut saw, which saves great waste in timber, and the use of which we should lose no time in introducing and making universal in the Government forests of India.

As each tree is felled, it is the duty of the forester to stamp the stump with a hammer, bearing the proprietor's initials, which he keeps in his possession, and can thus see if any unmarked tree has been felled, and the wood manager can, in like manner, check the felling and number of trees removed. In some cases the butt of the tree removed is also stamped.

This system, with some modifications, might, I think, be adopted with advantage in India, and the year might be added to the stamp.

The timber trees (coniferous) in Strathspey are divided for the purposes of sale into three sorts, viz., timber, spars, and props.

Under the former are classed all trees eight inches and more in diameter at twelve feet from the base.

Spars include all which are under eight inches and over five inches at twelve feet from the base.

Props are those below five inches at twelve and not less than three at six feet from the base. Anything below this is not classed.

Mr. Thomson gives the price of Scotch fir in Strathspey at 6*d.* per cubic foot all round, and larch at 1*s.* per cubic foot, but the demand for the latter is greater than the supply. At these rates all expenses of felling, carting, &c. are borne by the purchaser.

In a recent sale of thinnings, in Tomienour Wood, Mr. Thomson paid for felling and pruning (on contract) 5*s.* 6*d.* per hundred trees, and received for,—

			<i>s.</i>	<i>d.</i>
Scotch fir, timbers	-	-	3	6 each.
„ spars	-	-	1	3 „
„ props	-	-	0	8 „
Larch, timbers	-	-	5	0 „
„ spars	-	-	3	6 „
„ props	-	-	1	0 „

These rates, though not high, are very remunerative. I saw the thinning going on in the above wood and elsewhere. The trees selected were marked by a blaze on each side, on one of which the proprietor's initials were stamped. There is little or no pruning, and Mr. Thomson does not remove the lower (dead) branches from the trees. He is particularly fortunate as to game, there being very few rabbits, and his greatest enemies are the squirrels, which do a good deal of damage in severe winters, by eating the bark right round a young tree or branch. Even these, however, he is allowed to have shot, and pay a reward to the keepers of so much per tail.

Roads and Paths.—In all the new plantations Mr. Thomson is laying off paths about a yard wide, fit for dragging, and which may be widened and made into cart roads as required. There is no particular gradient maintained, and in many places they would be found too steep for our dragging or carting purposes in India. The paths generally run in parallel lines round and up the hill side, ascending to the very top even of Bengulapin (*i.e.* 2,000 feet above the sea), and are intersected by cross paths.

By the adoption of this system much trouble will eventually be saved, as we know, by experience, the difficulty of making paths or roads through a thick forest or plantation in which it is impossible to see more than a few yards in advance, and there is a double object, *viz.*, that the paths act as fire traces, and can be utilized in case of fire for forming a line of men, and preventing its extending to the rest of the plantation or wood.

The paths are cheaply made by contract at $1\frac{1}{2}d.$ per running yard.

Mr. Thomson is constructing rough cart roads on the same principle, and improving those which already existed. For those now being laid out he is paying $6d.$ per running yard, four yards in width, and the work is very well worth the money. We could not do the like in Madras for four times the amount; and, when it is remembered that a day's wages for a man is $2s. 2d.$, it appears marvelously cheap. The line is marked out by the forester, under Mr. Thomson's superintendence.

Fencing.—All the new fencing is wire, which is found far the best and cheapest in the long run. Thousands of acres have been thus enclosed, and I was fortunate enough to see the work in progress, and make myself practically acquainted with the method adopted.

There are six wires, that at the top being thickest, and known as No. 4, the other five wires being No. 6. The wire

costs $3\frac{1}{2}d.$ per running yard. The posts are supplied on contract, and delivered along the inclosure to be fenced at $3d.$ each, which Mr. Thomson finds cheaper than working them up and carting them by means of his own establishment. They are, as a rule, prepared from wood purchased from the estate, and sawn in the proprietor's saw mills, which are leased to wood merchants.

The straining posts, which are, as a rule, about 100 yards apart, the distance varying according to curves and dips, are $7\frac{1}{2}$ feet long by 7 inches square. They are sunk 3 ft. 8 in., or half their length, in the ground.

The intermediate posts ($5\frac{1}{4}$ ft. \times 5 in. \times $2\frac{1}{2}$ in.) are 6 feet apart, and sunk 1 ft. 8 in. in the ground. As a rule, the tops of the posts are sloped off, for appearance sake, and to allow of the rain running off.

When the posts which have been laid along the line by the contractor are firmly fixed in the holes (stays or supports being made use of when required in uneven ground), the wires are run in through staples, which are not, however, driven home till the wire is "strained," as will be explained further on.

The usual distance between the wires is as follows:—

		Ft.	in.
From top of post to 1st wire	-	0	2
Between 1st and 2nd wire	-	0	10
„ 2nd „ 3rd „	-	0	$7\frac{1}{2}$
„ 3rd „ 4th „	-	0	$6\frac{1}{2}$
„ 4th „ 5th „	-	0	6
„ 5th „ 6th „	-	0	6
„ 6th wire and surface of ground	-	0	6
Total	-	3	8

which is the height of the post out of the ground. In soft yielding ground the posts are made two inches longer, and 1 foot 10 inches in the ground.

The wires are strained at each straining post by means of instruments called strainers and collars, which have been improved and simplified by Mr. Grant Thomson, and his forester, Sampson. I think it most important that we should adopt the wire fencing for our plantations and reserves in Madras, and that our assistants and overseers should make themselves thoroughly acquainted with the *modus operandi*, which is very simple. I thought of trying it before I came home in inclosing the Pulney Hill plantations, and some of the railway reserves near Trichinopoly, but was deterred by the expense, as furnished me by the manager of the Great Southern of India Railway. I now

see that the wire made use of by that company is galvanized and twisted, which I cannot think necessary, as the "best drawn annealed" wire is found to last well if coated with tar. This is done by Mr. Thomson the year after the fence is put up, so as to allow of tightening, straightening posts, &c. Both posts and wire are thickly coated, and in India we should probably have to creosote the portion of the posts let into the ground, or, in fact, the whole post.

The whole cost of the fence, as put up by Mr. Thomson, is $7\frac{1}{2}d.$ per running yard, which he computes thus:—

			<i>d.</i>
Wire, per yard	-	-	- $3\frac{1}{2}$
Posts (each post being 3s., and standing two yards apart)	-	-	- $1\frac{1}{2}$
Work	-	-	- $1\frac{1}{2}$
Tarring	-	-	- $1\frac{1}{2}$
Extra for straining posts and staples	-	-	- $\frac{1}{2}$
			<hr/>
Total			- $7\frac{1}{2}$
			<hr/>

The rolled wire is inferior in quality and in shorter lengths, and should never be used. I propose making inquiries as to the cost of shipping the drawn annealed wire to Madrás, including insurance, &c., and shall have one or two of the improved Strathspey strainers and collars made, and take them with me on my return. The method of using them can easily be shown, but is difficult to describe in writing, and I have not therefore attempted it.

Floating.—This was formerly carried out to a large extent on the Spey and its tributaries, but is not now so much in use, and is quite discontinued on the Spey itself, owing to the construction of the railway and facilities for sawing up the timber in or close to the forest by means of portable steam sawing machines.

I visited one of the dams (known as the Big Dam) on the Nethy river in the Abernethy District, and made myself conversant with the methods adopted, which is simple and effective. By its aid, the trees are, in the case of the river or stream I allude to, floated right up to the saw mill (water) at Abernethy village.

I must premise that, were the stream to remain full long enough for the purpose, the logs would simply be floated down in the ordinary way (singly, not in rafts), watched and assisted by men on the banks; but this is rarely the case, and arrangements have to be made for storing water at several points on the way, which can be let into the main

stream as required in sufficient quantities to carry on the logs to their destination.

This is effected in the following manner :—

A temporary weir, constructed of logs and stones, is thrown across the river down which the timber is to be floated.

A channel is led from above this weir, to supply a reservoir made for the purpose, at the nearest eligible site in the vicinity of the river, the channel being furnished at its head with a sluice whereby the supply is regulated.

From the reservoir a channel is led to the river, meeting the river bank at a point considerably below the site of the weir, and this channel is also furnished, at its head, with a sluice whereby the supply to the river is regulated. By this arrangement water taken from the river, and stored in the reservoir, is capable of being used as an auxiliary power for floating the timber to a point considerably further down the river than could be reached by means of the water power in the river itself.

The various stages in the transit of the timber are these. It is floated by the available water-power in the river to a given point, and then stranded. Immediately below this point the temporary weir above described is constructed. This raises the water sufficiently to float the timber once more, and the weir being removed, the timber is carried on to a point further down the river, and again stranded. At this second point is the mouth of the channel led from the reservoir; the sluice at the head of this channel being opened, the water stored in the reservoir flows down the channel into the river, the timber is again floated, and is thus carried on to its destination.

There are, of course, as many dams as are found necessary along a river, and the process may be repeated as often as required.

The "Big Dam" which I saw was about 90 yards long, 10 feet high, and about 15 yards thick at the base, the sluice fitted with two doors or vents raised by a powerful lever, being in the centre. The reservoir, which covered a large area when full, can be filled in two to three days, and the water is sufficient, when let on, to keep the river in floating order for four hours. The accompanying rough sketch will perhaps explain better than any written description. (*Vide* Plate I.)

The work of construction is all done by the forest establishments, and though rough, and not calculated for the sudden freshes of an Indian mountain stream, it answers the purpose here, where, however, the men can be more relied on to go and open the sluice gates of the main dam,

or to shut that leading from the river, in the event of very heavy and continued rains. A self-closing sluice for the latter would probably be found necessary in India to prevent danger of the main dam being carried away or breached, or the simplest arrangement for safety would be an escape in the river bank, just above the weir, as shown at G in the sketch.

Saw Mills (Water Power).—I gave particular attention to the saw-mills and machinery throughout my tour, and here inspected that at Abernethy, to which the logs are floated down as already described.

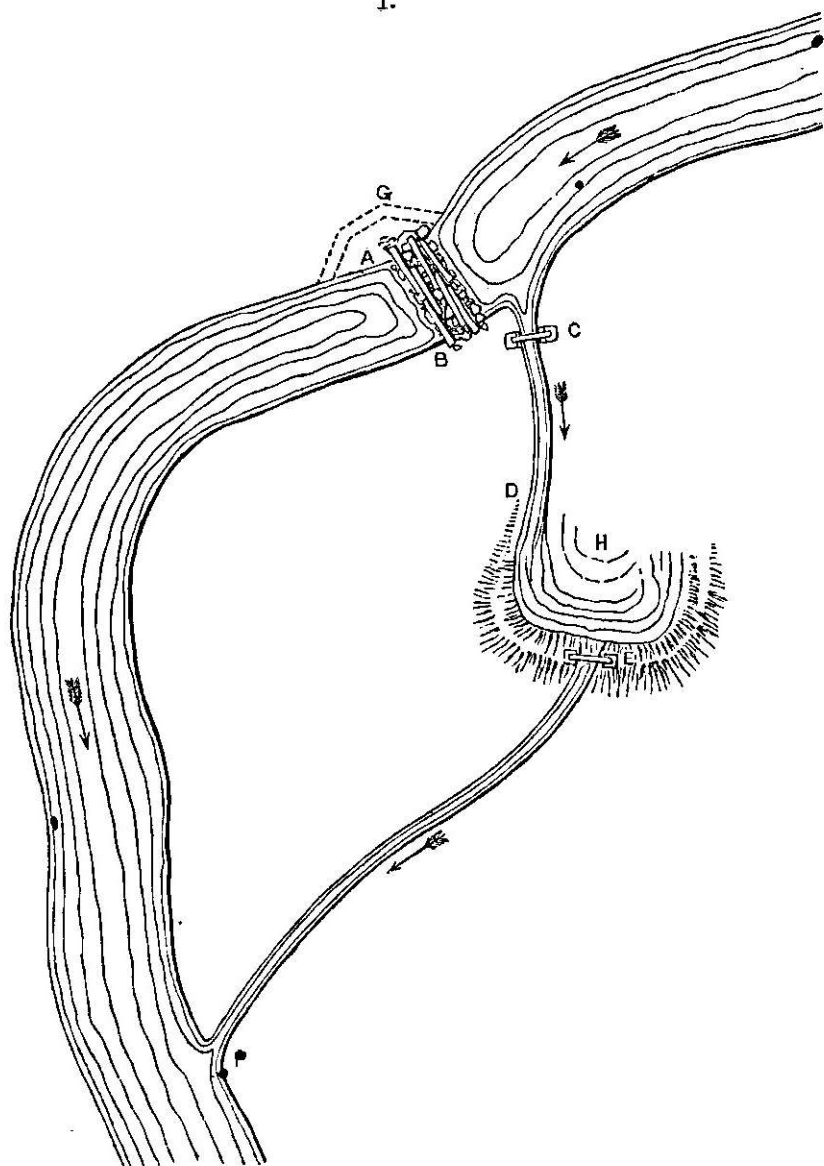
There are two wheels, drawing two separate sets of machinery, in adjoining sheds, one 14-foot breast wheel, with segment and $4\frac{1}{2}$ -foot drum, single action, driving four circular saws when required. The action is very simple and effective. The other is a small 4-foot breast wheel, turning a crank which works a vertical band-frame saw. (*Vide* Plates II. and III.)

This appears particularly simple and useful for squaring large beams, and could be easily constructed and put up in our Indian forests, having the great advantage that there is scarcely any iron employed. All there is could be easily done by a village blacksmith.

Grazing.—I made particular inquiries on this point, in order to ascertain the usage, as the case of this estate, with 60,000 acres under what may be called the Strathspey Forest Department, in the midst of a great grazing county, bears some analogy to the question in Madras, where every little inclosure for planting, or formation of reserves, is apt to be met with an outcry, as lessening the extent available for pasture. I have invariably argued in India that not only did our inclosures make no appreciable difference in the enormous extent of hill pasture available, to which they bear, and always should bear, a very small proportion, but that eventually grazing might be allowed in the plantations and reserves, and the pasture would be found to be improved. I now find that this is exactly the case here, where ordinary pasture land on the hill sides lets for 6*d.*, and that of inclosed plantations for 2*s.* 6*d.* an acre, the one being as strictly reserved to the renter only as the other.

The practice with existing woods or plantations, over 15 or 20 years old, is to let the grazing for a term of years on the condition that the renter puts up the fence and keeps it in repair, the landlord providing the posts in the first instance, but not the wire nor work. At the expiration of the lease, if not renewed, the landlord has the option of taking

I.



AB. Temporary weir constructed of logs and stones.

CD. Supply channel led from above weir to reservoir.

EF. Channel led from reservoir to river's bank.

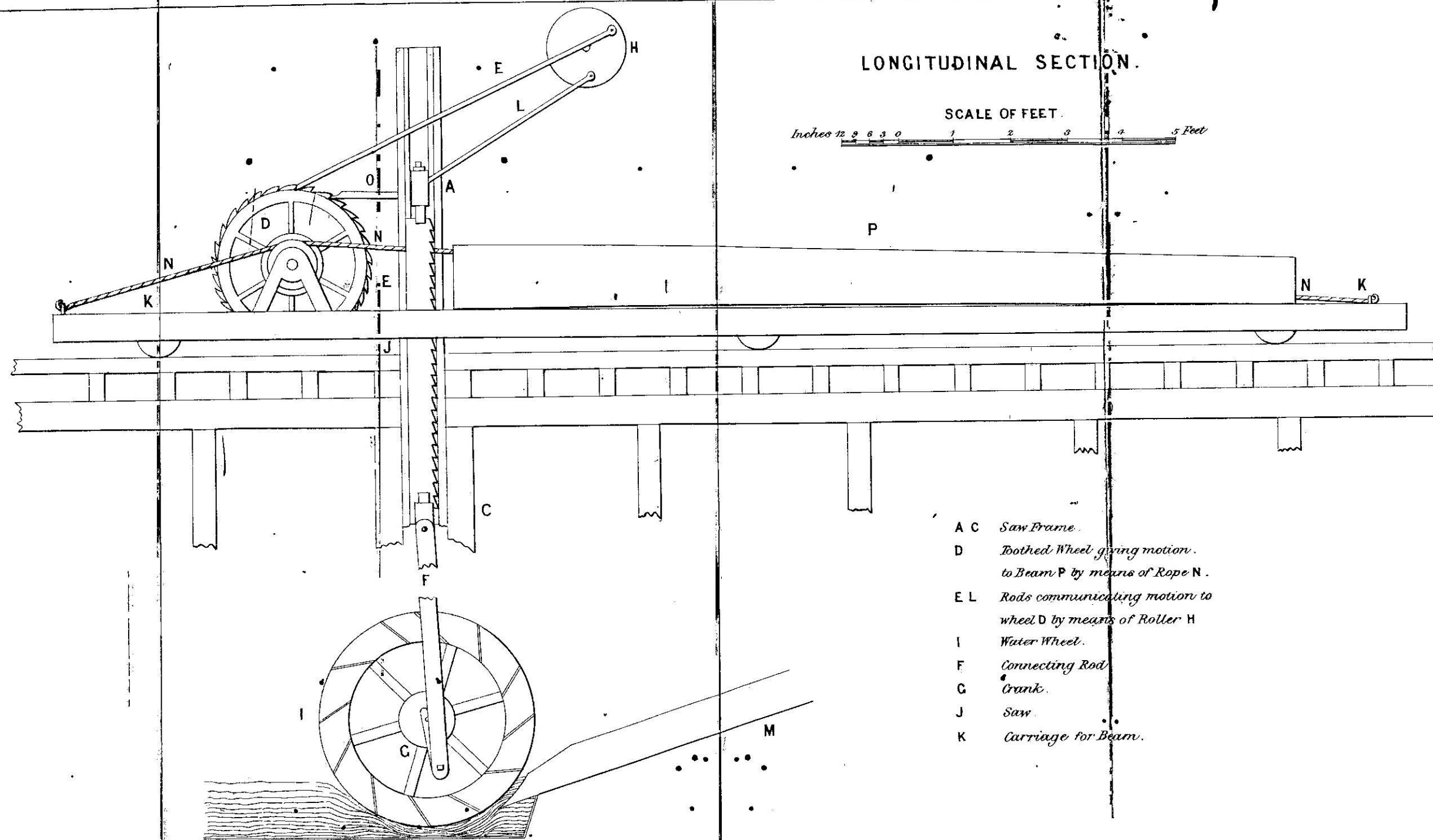
G. Escape channel or bye-wash.

H. Reservoir.

E and C. Sluices at the heads of the two channels above named, to regulate supply from same.

LONGITUDINAL SECTION.

SCALE OF FEET.
Inches 12 9 6 3 0 1 2 3 4 5 Feet



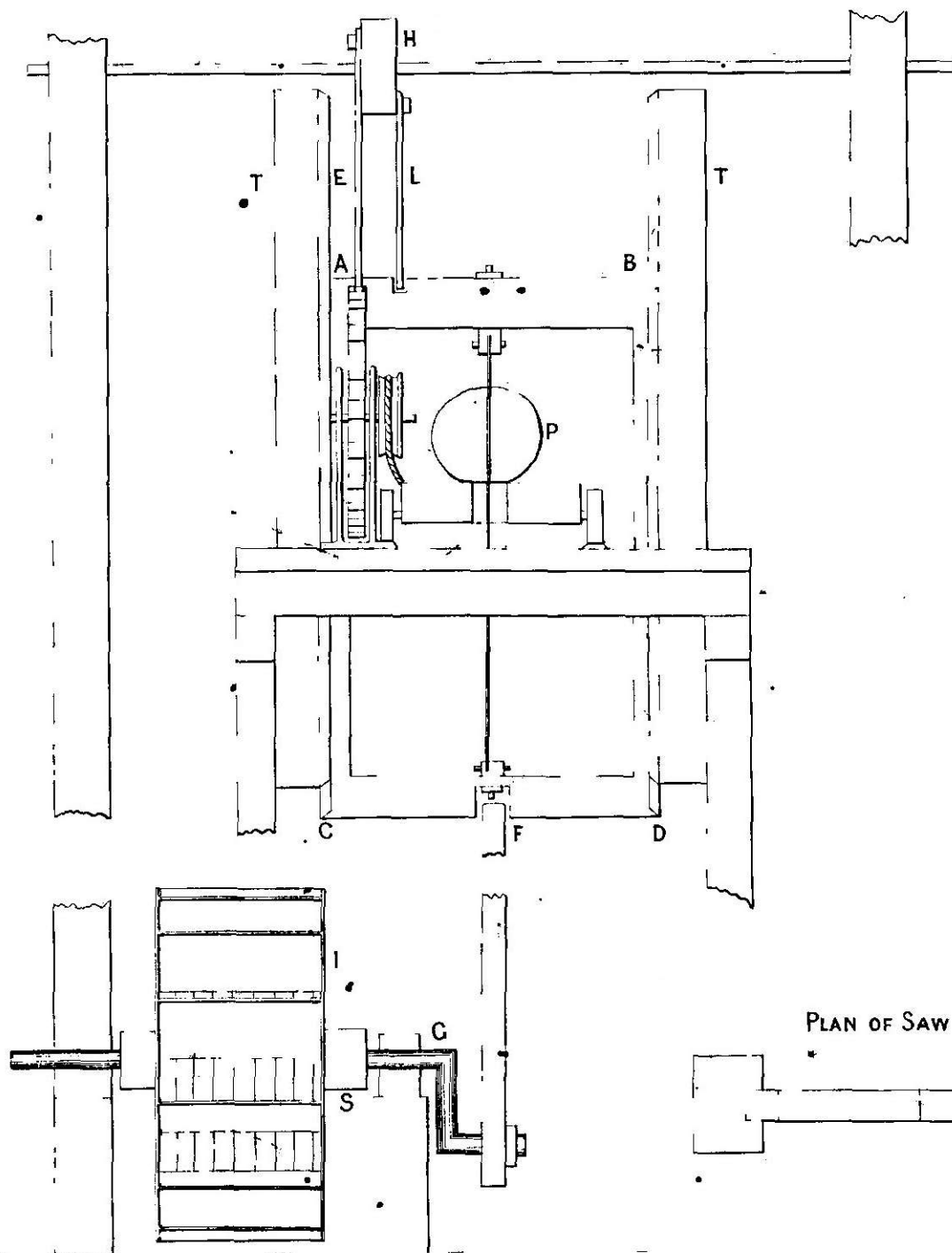
- A C Saw Frame.
- D Toothed Wheel giving motion.
to Beam P by means of Rope N.
- E L Rods communicating motion to
wheel D by means of Roller H
- I Water Wheel.
- F Connecting Rod
- G Crank.
- J Saw
- K Carriage for Beam.

CROSS SECTION.

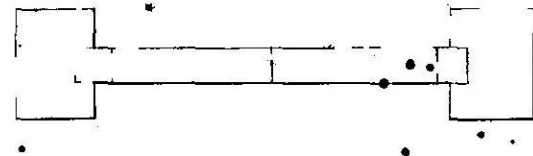
SCALE OF FEET



- I Water Wheel 4' Diameter 2' broad
- S Axle of Do, 8' " 6' "
- F Driving Rod 11' x 4' x 4'
- C Crank of 2 1/4" Sq. Iron
- ABCD. Saw Frame having 2 Vertical pieces, 3 3/4' x 3 3/4' and 2 cross heads 7 1/2' x 3 3/4' Interior measurement 5' 4' x 3' 5'
- TT Guides for Saw Frame.



PLAN OF SAW FRAME.



over the wire and work at a valuation, or arranging for the incoming tenant's doing so. The pasture, particularly under larch, is much better than elsewhere, and the trees afford shelter for the sheep from the excessive cold in the winter (as they would in India from the excessive heat in the hot weather on the plains, and on the hills from the rain and cold winds), whilst, on the other hand, the landlord gets an enhanced rent, and has his fences put up and kept in repair.

From young plantations or natural woods all men and cattle are rigidly excluded, as well as from tracts from which a crop of timber has recently been removed, and which, according to Mr. Thomson's system, is allowed to lie entirely fallow for some time. It often happens, however, that enclosures are made, or exist, before the forest establishments are ready to plant them. In these cases the grazing is rented, and often goes a long way to pay for the fencing. I trust we may yet arrive at some such system in India, allowing, of course, a wide margin for the people's actual requirements in the shape of grazing for their cattle, sheep, and goats, but not hesitating to take up, for planting or reserve, any of the residue which may be required to be thrown open again, or rented, as thought fit, when the trees have grown out of harm's way.

Explanatory Memorandum of Plates II. and III.

VERTICAL SAW MILL WORKED BY WATER POWER.

This is effected in the following manner (see transverse and longitudinal sections) :—

Water is led along the shoot *M* on to the breast wheel *I*, acting on it partly by weight and partly by impulse, and escaping under the wheel. The wheel, in revolving, communicates motion to the crank *G*, which is attached to the driving rod *F*. This rod is secured to the bottom cross-head *C, D*, of the saw frame *A, B, C, D*. This frame works in guides, and it will be seen that the revolutions of the water wheel communicate vertical motion to the saw *E*, which is firmly secured to the cross-heads of the frame.

The beam to be sawn travels on a carriage *K*, to which slow motion is communicated by means of the rods *E* and *L*, the roller *H*, the toothed wheel *D*, and the cord *N*. This is so apparent from an inspection of the figure, that no detailed description is necessary.

The ratchet *O* falls into its place in the circumference of the toothed wheel *D* at each stroke of the saw, and thus keeps the wheel in its place.